FIGs. 11A-11D are various views of a broth container useful within the present invention;

FIGs. 12A and 12B are perspective views of the broth container of FIG. 11;

a a1

FIG. 13 is a schematic elevation view of a vortex mixer useful within the present invention;

FIG. 14A is a perspective view of a broth canister useful within the present invention;

FIG. 14B is a sectional view of the broth canister of FIG. 14A;

FIGs. 15A-H and 15J-M illustrate the functions of the sample pipetting and transport system of FIG. 3 in filling the AST test arrays of FIG. 5;

FIG. 16 is a side elevation view of an ID rotor robotic device useful within the present invention;

FIG. 17 is a perspective view of an AST array carrier useful within the present invention;

FIG. 18 is a perspective view of an AST carrier transport useful within the present invention;

FIG. 18A is a perspective view of the AST array carrier of FIG. 17 nested within a AST carrier transport of FIG. 18 useful within the present invention;

FIG. 19 is a top plan view of an AST array dispenser useful within the present invention;

FIG. 20 is a view of an AST carrier transport useful within the present invention;

FIG. 21 is a view of an broth container handling apparatus useful within the present invention;

FIGs. 21A and 21B are enlarged views of a portion of the broth container handling apparatus of FIG. 21;

FIG. 22 is a view of an ID rotor filling and centrifuge device useful within the present invention;

aa

aa2

The plurality of different broth cups or containers 14 (FIG. 2, left side) are maintained in an on-board inventory within analyzer 10 in different tube-like broth canisters 24, FIG. 14A, and the broth canisters 24 are maintained on a rotatable carousel 26, hereinafter called the B/ID carousel 26, the B/ID carousel 26 being housed within an environmentally controlled B/ID chamber 28 (shown with its top portion removed for purposes of illustration). A rotating motor 25 is operated as required to rotate the B/ID carousel 26 so as to present a required broth canister 24 and broth container 14 to a broth container handling device described later. The different broth containers 14 are preloaded with a number of different standard broth solutions that act as a growth media during AST testing. In FIG. 2, the B/ID chamber 28 is shown with a door 30 in an opened position to allow operating access to the inside of the B/ID chamber 28. The broth canisters 24 are shown as being made of a transparent material or as cut-away in order to shown four broth containers 14 contained within the broth canisters 24. In a exemplary embodiment, as many as twenty broth containers 14 would be contained within each broth canister 24 and as many as fourteen broth canisters 24 would be housed within the B/ID chamber 28. An important feature of analyzer 10 is a magnetic mixing member within each broth container 14 and an associated vortex mixer 93, both described later, provided so as to properly mix patient sample disposed into broth containers 14 with broth solution contained within broth containers 14.

In a similar manner, the analyzer 10 has an on-board inventory of different ID test rotors 16 described hereinafter, FIG 8, that are maintained in an inventory within analyzer 10 in different tube-like ID canisters 32, FIG. 10, and the ID canisters 32 are maintained along with broth canisters 24 on the B/ID carousel 26 within B/ID chamber 28. The different ID test rotors 16 are preloaded with substrates and reagents that are selected to produce a known pattern of measurable reaction signals which correspond to various known microorganisms. Motor 25 is also operated as required to rotate the B/ID carousel 26 so as to present a required ID canister 32 and ID test rotor 16 to a rotor handling device described later. In an exemplary embodiment, as many as eighty ID test rotors 16 would be contained within each ID canister 32 and as many as four ID canisters 32 would be housed upon the B/ID carousel 26.

aa

In the embodiment described, a disk 266 encases magnetic field source 258 as shown. In the exemplary embodiment shown in FIG. 13, the magnetic field source 258 comprises a permanent or semi-permanent magnet 258 and magnetic mixing member 254 is caused to revolve by rotating the permanent or semi-permanent magnet 258 at close proximity to the broth container 14 using a mixing motor 260 with a mixing motor shaft 262 having the disk 266 attached thereto. The term ferromagnetic is intended to mean a substance having a sufficiently high magnetic permeability to be positionally affected by an orbiting or rotating magnetic field.

aa3

FIG. 14A is a perspective view of a closed elongate broth canister 24 having a generally rectangular cross-section (FIG. 14B) formed by a broth canister front wall 320, ID canister back wall 321 and two ID canister side walls 322, the front wall 320, back wall 321 and side walls 322 of essentially similar dimensions so that a squarely shaped interior is formed to house a plurality of broth containers 14 stacked one atop another. A top end portion 324 and a bottom end portion 326 close the ends of broth canister 24. Typically, broth canister 24 is formed as an indented sheet of plastic and is folded in half creating a external rib 325 extending the full length of broth canister 24 between broth canister back wall 321 and a side wall 322 (FIG. 14B). An opposed elongate broth canister seal flange 323 is created in a sealing operation and also extends the full length of broth canister 24 between broth canister back wall 321 and a side wall 322. A number of surface bumps 328 are formed in opposing pairs of finger pads 327 formed in top end portion 324 to facilitate handling of a broth canister 24 by an operator. FIG. 14B is a sectional view of broth canister 24 and best illustrates the broth canister seal flange 323, broth canister external rib 325 and internal ribs 328.

Key features of the broth canister 24 include a broth canister mounting flange 324 shaped to seat into a mounting groove 331 (FIG. 1) within B/ID chamber 28 so that a broth canister 24 may be placed using a number of finger pads 327 in a vertical position whereat two spring-loaded latching cams within B/ID chamber 28 snap over latch steps 329 formed at opposing ends of a latching flange 330 extending upwardly above top end portion 324. The portion of latching flange 330 between steps 328 is confined between spring-loaded latching cams to provide proper vertical orientation. FIG. 14A is an enlarged view of the bottom end portion 326 of broth canister 24 showing details of a

aa

broth eject port 332 formed in broth canister front wall 320 proximate mounting flange 324 and sized to allow the lowermost broth container 14 within the plurality of broth containers 14 stacked one atop another to be pulled out of broth canister 24. Broth containers 14 may be pulled out of broth canister 32 through broth eject port 332 by broth clamping members 109 located at the end of moveable broth arms 238 of broth robotic device 108 (FIG. 21). Broth eject port 332 has the shape of a rectangular opening formed between a pair of depressions 334 having a flat portion 336 between the depressions 334. The flat portion 336 functions as a horizontal broth container sliding surface to support broth containers 14 as they are pulled out of broth canister 24 through broth eject port 332. A tongue flap projection 338 formed in front wall 320 extends downwardly and partially into the eject port 332 to prevent broth containers 14 from being dislodged accidentally from canister 24 and also to prevent broth containers 14 from being improperly inserted back into canister 24.

aa4

FIGs. 15A-H and 15J-M illustrate the operation of sample pipetting and transport system 60 of FIG. 3 in filling the AST test arrays of FIG. 5 in the previously mentioned AST carrier 74 "build and fill" process. FIGs. 15A-15L are simplified so as to clearly illustrate important improvements in high speed filling of AST test arrays 12 and AST test microwells 124 with liquid sample aspirated from sample tubes 34 by pipetting apparatus 46, and are an important advantage of the present invention, being derived from the single pipetting apparatus 46 being operational in two opposed directions along the single linear path defined by the loci L of positions 46a-46e as defined above such that AST test arrays 12 may be filled with sample-inoculum at a plurality of positions along loci L.

Beginning with FIG. 15A, an AST carrier 74 partially loaded with AST test arrays 12 and supported on AST array carrier bed 80B is seen positioned between AST carrier transporter 76 and AST array dispenser 84. In these FIGs., two identical AST array carrier beds are identified as 80A and 80B for purposes of discussion. AST array carrier bed 80A is seen as being empty in FIG. 15A. As discussed earlier, AST array dispenser 84 is adapted to remove AST test arrays 12 from an AST canister 18 in the form of a singulated stream and to successively place the AST arrays 12 within a number of empty AST array slots 86 formed within an AST carrier 74 as the AST carrier 74 is advanced along a first direction on carried by AST array carrier bed 80B (arrow pointing "upwards" in FIG. 15A

aa

"chases" AST array carrier 74 to deposit inoculum-broth into the AST test arrays 12 carried thereby. This process continues until the stage depicted in FIG. 15H is reached, when all AST array slots 86 within AST array carrier 74 are filled at which stage the direction of motion of AST array carrier 74 reverses to the "upwards direction". (For purposes of clarity, there is no FIG. 15I.)

aa5

Filling of AST arrays 12 on AST array carrier 74 by pipetting apparatus 46 continues until the empty AST array carrier bed 80B is in alignment with AST carrier transporter 76 at which stage, FIG. 15J, AST array carrier transport 78 is stopped and an unloaded AST array carrier 74 is placed on empty AST array carrier bed 80B by AST carrier transporter 76, and the direction of motion of AST array carrier transport 78 reverses once again to the "downwards direction" (FIG. 15K). During this stage, as soon as a single AST test array 12 has been loaded onto AST array carrier 74, pipetting apparatus 46 "chases" AST array carrier 74 to deposit inoculum-broth into the AST test arrays 12 carried thereby. FIG. 15K illustrates an important portion of the movements during which pipetting apparatus 46 is at fixed position 46c to aspirate inoculum-broth solution from broth container 14 as it also "chases" AST array carrier 74.

Movement in the "downwards direction" continues (FIG. 15K) until the AST array carrier 74 having all filled AST arrays 12 is in alignment with AST carrier transporter 76 at which stage, FIG. 15L, AST array carrier transport 78 is stopped, the AST array carrier 74 is removed by AST carrier transporter 76; the direction of motion of AST array carrier transport 78 reverses once again to the "upwards direction" so that the unloaded AST array carrier 74 on 80B may next be loaded with AST arrays 12 by AST array dispenser 84.

As before the AST array carrier 74 loading process begins and as soon as an unfilled AST array 12 is positioned upon AST array carrier 74, pipetting apparatus 46 begins depositing a known amount of inoculum-broth into an AST test array 12. This situation exactly replicated the AST array loading and filling stage of FIG. 15A enabling the AST array filling process to continue without stopping by automatically proceeding to the AST array 12 filling stages depicted by FIGs. 15A-M.

It should be understood that the feature of analyzer 10 in which a single pipetting apparatus 46 operational in two opposed directions along a single linear path defined by

aa